Supreme Court, U.S.

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OFFICE OF

No. 01-

IN THE

Supreme Court of the United States

LOCKHEED MARTIN CORPORATION,

Petitioner,

v.

SPACE SYSTEMS/LORAL, INC.

ON PETITION FOR WRIT OF CERTIORARI
TO THE UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

PETITION FOR WRIT OF CERTIORARI

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QUESTIONS PRESENTED

The Federal Circuit's decision below rests entirely on the "absolute bar" rule announced in *Festo Corp. v. Shoketsu Kinxoku Kogyo Kabushiki Co.*, 234 F.3d 558 (Fed. Cir. 2000) (*en banc*), cert. gntd., __ U.S. __ (June 18, 2001) (No. 00-1543). In *Festo*, the Federal Circuit held that a patent applicant who narrows a patent claim by adding a new limitation forfeits all right to rely upon the doctrine of equivalents as to such limitation. In this case, the Federal Circuit took *Festo* one step further and applied the "absolute bar" rule to a claim limitation which was not added by amendment, but rather was part of the original claim.

On June 18, 2001, in No. 00-1543, this Court granted certiorari in *Festo*. If *Festo* is reversed or modified, it would warrant vacating the decision in this case as well. However, in addition to the questions already raised in the pending *Festo* appeal, Lockheed Martin presents the following questions:

1) What judicial basis supports a change from the flexible bar rule, which was rooted in the Court's inherent equity powers, to the absolute bar rule announced in *Festo*, which is not based on traditional principles of equity?

2) Where a clause in a patent claim originally recites one limitation, and is amended to add a second, arguably related but entirely distinct limitation, does the "absolute bar" rule apply to both limitations, as the Federal Circuit held below, or merely to the limitation added by amendment?

PARTIES TO THE PROCEEDING

The parties to this proceeding are Lockheed Martin Corporation, plaintiff below, and Space Systems/Loral, Inc., the defendant below.

Lockheed Martin Corporation has no parent, and no publicly held company owns 10% or more of Lockheed Martin's stock.

TABLE OF CONTENTS

QUESTIONS PRESENTED i

PARTIES TO THE PROCEEDING ii

TABLE OF AUTHORITIES iv

OPINIONS BELOW 1

JURISDICTION 1

CONSTITUTIONAL AND STATUTORY PROVISIONS INVOLVED 1

STATEMENT OF THE CASE 2

1. The '772 Invention 3

2. The Decision Below 3

3. The Relevant Prosecution History 4

REASONS FOR GRANTING THE WRIT 5

A. The Absolute Bar Rule Announced In Festo Cannot Be Justified Under the Principles Of Equity 5

B. The Extension of the "Absolute Bar" Rule To Claim Limitations Not Added By Amendment Is Unwarranted 10

CONCLUSION 12

TABLE OF AUTHORITIES

Cases

Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd., 234 F.3d 588 (Fed. Cir. 2000) .. passim

Graver Tank Co. v. Linde Air Prod. Co., 339 U.S. 605 (1950) 6

Hughes Aircraft v. United States, 717 F.2d 1351 (Fed. Cir. 1983) 7

Insituform Technologies, Inc. v. Cat Contracting, Inc., 99 F.3d 1098 (Fed. Cir. 1996), cert. denied, __ U.S. ___ 7

Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17 (1997) 6, 9, 10

Statutes

35 U.S.C. § 112 . . . . . 1, 6

35 U.S.C. § 132 . . . . . 2, 7, 8

35 U.S.C. § 271 . . . . . 2, 6, 7

Other

III John N. Pomeroy, A Treatise on Equity Jurisprudence § 804 (5th Ed. 1941) 8

Lockheed Martin Corporation ("Lockheed Martin") hereby petitions for a writ of *certiorari* to review the judgment below of the United States Court of Appeals for the Federal Circuit.

OPINION BELOW

The Federal Circuit's decision below is reported at 249 F.3d 1314 and is set forth in the Appendix hereto at A-1 - A-24. On June 25, 2001, the Federal Circuit denied Lockheed Martin's request for rehearing *en banc*. A-25 - A-27.

JURISDICTION

The Federal Circuit denied Lockheed Martin's petition for rehearing en banc on June 25, 2001. A-26. This petition is being filed within 90 days of the order denying rehearing, pursuant to Supreme Court Rule 13. This Court has jurisdiction under 28 U.S.C. § 1254(1).

CONSTITUTIONAL AND STATUTORY PROVISIONS INVOLVED

This controversy arose under the Patent Statute, 35 U.S.C. § 1 *et seq.* Lockheed Martin believes that three sections of the Patent Statute are relevant to this petition.

35 U.S.C. § 112, second paragraph, provides:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

35 U.S.C. § 271(a) provides:

> Except as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefor, infringes upon the patent.

35 U.S.C. § 132(a) provides:

> Whenever, on examination, any claim for a patent is rejected, or any objection or requirement is made, the Director shall notify the applicant thereof, stating the reasons for such rejection, or objection or requirement, together with such information or references as may be useful in judging the propriety of continuing the prosecution of his application; and if after receiving such notice the applicant persists in his claim for a patent, with or without amendment, the application shall be reexamined. No amendment shall introduce new matter into the disclosure of the invention.

STATEMENT OF THE CASE

Lockheed Martin alleges that the Intelsat VII satellite, and certain related satellites, manufactured and sold by Space Systems/Loral, Inc. ("SSL"), infringe upon U.S. patent No. 4,084,772 (the '772 patent), entitled "Roll/Yaw Body Steering For Momentum Biased Spacecraft."

1. The '772 Invention

The '772 patent relates to geosynchronous satellites of the type which orbit the earth in an equatorial plane at the rate of one orbit per day. Because the orbit is synchronous with the rotation of the earth, such satellites appear to remain stationary in the sky. A-3.

Geosynchronous satellites are subject to various destabilizing forces which can cause the satellite to drift into an orbit which is inclined relative to the equatorial plane ("inclined orbit"). A-4. Although their orbit is still synchronous with the rotation of the earth, due to the tilt of the orbit plane the satellites will appear from the ground to be moving north and south over the course of the day. This movement produces a sinusoidally varying error in the north-south pointing direction of the satellite's antennas. *Id.*

Claim 1, set out at A-8 - A-10, is directed to a system for continuously compensating for such error. The claimed system varies the speed of a momentum wheel which is parallel to the yaw axis of the satellite (which the patent refers to as a "transverse wheel" or "yaw wheel"), which in turn changes the north-south pointing direction of the satellite, sinusoidally over the course of the day. By doing so, the satellite's antennas remain pointing at the same location on the earth's surface, even though the satellite itself is continuously moving in a north-south direction. A-6 - A-7.

2. The Decision Below

The Federal Circuit affirmed the District Court's summary judgment ruling (set out at A-30 - A-44) of non-infringement, but not on any of the grounds upon which the District Court relied. Rather, the Federal Circuit held that its intervening ruling in *Festo* pre-

cluded any finding of infringement of clause "b" of claim 1, in particular the limitation reciting that the speed of the transverse wheel is varied according to a rate schedule which varies "sinusoidally." A-23.

The Federal Circuit construed the term "sinusoidally" to mean "a variation in a sine-shaped curve that passes through zero [speed]." A-18. Lockheed Martin conceded that the transverse wheels in SSL's satellites do not pass through zero speed, and therefore its satellites do not literally infringe. A-19. However, Lockheed Martin presented evidence that SSL's wheel control system constitutes an equivalent. A-19 - A-20.

The Federal Circuit held, however, based on *Festo*, that the "through zero speed" limitation in clause "b" was entitled to no scope of equivalency, because clause "b" had been narrowed during prosecution to add another limitation, i.e., a limitation that the speed of the wheel varies "over the orbit at the orbital frequency of the satellite" (hereafter referred to as the "orbital frequency" limitation). A-23.

Lockheed Martin requested a rehearing *en banc* to review the panel's holding that adding a new claim limitation invokes the absolute bar rule to other claim limitations already present. Lockheed Martin's petition was denied on June 25, 2001, without opinion. A-25 - A-27.

3. The Relevant Prosecution History

Claim 1, as originally filed, contained the limitation "sinusoidally," but did not contain the "orbital frequency" limitation. A-21. The latter limitation was added in response to two rejections over prior art. *Id.*.

As noted above, the Federal Circuit construed the term "sinusoidally" to include the limitation "through zero speed." A-18. Thus, the limitation "through zero speed" was part of original claim 1 and not added by amendment.

The reason for adding the "orbital frequency" limitation to claim 1 was explained in "Remarks" submitted during the prosecution history of the '772 patent. A-28 - A-29. The reason was to distinguish the frequency of wheel speed variation in claim 1 (once per day) from the much shorter frequency of wheel speed variation (several minutes) disclosed in the prior art. A-22. Thus, the addition of the "orbital frequency" limitation had nothing to do with, nor any effect on, the "through zero speed" limitation already in the claim.

REASONS FOR GRANTING THE WRIT

Lockheed Martin believes there are two reasons for granting the writ: (A) *Festo* was decided incorrectly; and (B) even if the "absolute bar" rule is affirmed as to limitations added by amendment, the rule should not be extended to eliminate the doctrine of equivalents relative to limitations which were part of the original claim, as the Federal Circuit did here.

A. The Absolute Bar Rule Announced In Festo Cannot Be Justified Under the Principles Of Equity

Lockheed Martin concurs with, and incorporates herein, the various public policy arguments advanced in the Petition For Writ Of Certiorari in *Festo* and the nine amicus briefs urging that *Festo* be overturned. Moreover Lockheed Martin believes that the "absolute bar" rule should be overturned because it is not based

on the inherent equity powers of the courts, but rather constitutes impermissible judicial legislation.

35 U.S.C. § 112 provides that patents must include "one or more claims." A-45 However, 35 U.S.C. § 271, the infringement section of the Patent Statute, *Id.*, does not expressly tie infringement to the words of the claims:

> (a) . . . whoever without authority makes, uses, offers to sell or sells any **patented invention** . . . infringes the patent. [emphasis added]

In *Graver Tank Co. v. Linde Air Prod. Co.*, 339 U.S. 605 (1950), this Court held that the scope of protection of a patent is not limited to the literal words of the claim, but also extends to equivalents. The Court explained:

> The theory on which [the doctrine of equivalents] is founded is that "if two devices do the same work in substantially the same way, and accomplish substantially the same result, they are the same, even though they differ in name, form, or shape." [citing precedent]

Graver Tank, 339 U.S. at 608. In other words, the Court viewed the doctrine of equivalents as a matter of statutory construction. By including equivalents within the scope of protection of a patent, the Court merely construed the statute broadly based on public policy considerations. *See, Warner-Jenkinson Co., Inc. v. Hilton Davis Chemical Co.*, 520 U.S. 17, 35 (1997). Indeed, the doctrine of equivalents must be a statutory grant, be-

cause there is no common law right to patent protection.

No provision of the Patent Statute provides that amended claims are to be treated differently from unamended claims, i.e., that by amending a claim, the patentee forfeits part of the exclusive rights granted by Section 271. To the contrary, 35 U.S.C. § 132 recognizes the right to amend the claims as part of the normal prosecution process. A-45.

Nonetheless, the courts have used their inherent equity powers to limit the scope of equivalency, when claims are amended, based on the equitable doctrine of "prosecution history estoppel." *Insituform Technologies, Inc. v. Cat Contracting, Inc.*, 99 F.3d 1098, 1107 (Fed. Cir. 1996). Such doctrine prevents a patentee from recapturing in litigation subject matter which was surrendered in the Patent and Trademark Office in order to obtain the patent. *Id.*

For almost 20 years, beginning with *Hughes Aircraft v. United States*, 717 F.2d 1351 (Fed. Cir. 1983), the Federal Circuit has rejected the view that prosecution history estoppel, when present, necessarily bars all equivalents. *Festo*, 234 F.3d at 599 (Judge Michel, dissent). Rather, the court has applied a flexible bar approach, in which the scope of estoppel depends upon "what a competitor, reading the prosecution history, would reasonably conclude was given up by the applicant" in order to obtain the patent. *Insituform*, 99 F.3d at 1107-08. Thus, prosecution history estoppel based on the flexible bar rule was tied to traditional notions of equity, i.e., that a patentee was estopped from reclaiming only what the public could reasonably conclude had been surrendered.

In *Festo*, a sharply divided court abandoned such standard, and adopted the "absolute bar" rule, holding that any claim amendment which narrows the scope of a claim, for any reason relating to patentability, precludes any scope of equivalency as to such claim limitation. *Festo*, 234 F.3d at 578.

The sole conduct by which patent applicants forfeit any equivalents is narrowing of a patent claim. However, 35 U.S.C. § 132 permits applicants to amend claims during the prosecution of patent applications. Neither Section 132 nor any other provision of the statute provides that applicants who exercise this right should be penalized for doing so. Therefore, if justified the "absolute bar" rule must be based on principles of equity.

Equitable estoppel has been defined as:

> the effect of the voluntary conduct of a part whereby he is absolutely precluded, both at law and equity, from asserting rights which might perhaps have otherwise existed, either of property , or contract, or of remedy, as against another person, who has in good faith relied upon such conduct, and has been led thereby to change his position for the worse, and who on his part acquires some corresponding right, either of property, of contract, or of remedy.

III John N. Pomeroy, A Treatise on Equity Jurisprudence § 804 (5th Ed.1941).

Prior to *Festo*, courts had consistently ruled that amending a claim alone was not a sufficient basis for the public to conclude that all equivalents had been

disclaimed. During the lifetime of the '772 patent (the "772 patent expired in 1995), the "flexible bar" rule remained the law, and thus there was never any basis for the public to conclude in good faith that Lockheed Martin disclaimed equivalents as to the "through zero speed" limitation. Thus, with respect to the '772 patent, the "absolute bar" rule cannot be justified based on principles of equity.

Here, there is no question that, in amending claim 1, Lockheed Martin disclaimed coverage for sinusoidal variation at time periods other than at the orbit frequency. But, Lockheed Martin never, by words or conduct, gave any indication to the public that it was disclaiming any right to the doctrine of equivalents with respect to the "through zero speed" limitation. Therefore, principles of estoppel do not justify denying Lockheed Martin a scope of equivalency.

As to future patents, the "absolute bar" rule could only be justified if the Federal Circuit has the power to decree unilaterally (as it purports to do in *Festo*)that the mere fact of amending claims, for any reason, results in forfeiture of all equivalents. However, the principles of estoppel do not provide it with any basis to make such a pronouncement.

The fact that the "absolute bar rule" eliminates the doctrine of equivalents, regardless of the reason for and circumstances surrounding an amendment, shows that it is arbitrary and amounts to judicial legislation. Moreover, barring recourse to the doctrine of equivalents whenever a claim is narrowed, regardless of the reason, is contrary to this Court's decision in *Warner-Jenkinson*.

In *Warner-Jenkinson*, this Court stated that the stated reasons for amending a claim were relevant to

the determination of prosecution history estoppel. *Warner-Jenkinson*, 520 U.S. at 30. Here, the reason for the amendment to clause "b" of claim 1 was fully explained. A-28 - A-29; A-22. The public was given notice that the reason why the "orbit frequency" limitation was added was to disclaim wheel speed variation frequencies other than once per day. Such amendment and remarks gave the public no basis to conclude that the patent applicant was disclaiming coverage with respect to the "through zero speed" limitation, and therefore there is no basis for imposing an estoppel with respect to the "through zero speed" limitation.

The Federal Circuit adopted the absolute bar rule out of concern that the "flexible bar" rule creates uncertainty. *Festo*, 234 F.3d at 575. However, the flexible bar rule creates no more uncertainty than the doctrine of equivalents itself. Even if the Federal Circuit believes that the patent laws would be better served by a bright line forfeiture rule, Congress has not adopted such a rule. And, while the role of the Federal Circuit is to promote uniformity in the patent laws, that role does not include what amounts to legislation.

In addition to the reasons advanced in the pending *Festo* appeal, Lockheed Martin respectfully submits that the "absolute bar" rule goes beyond the courts' inherent equity powers, and should be overturned.

B. *The Extension of the "Absolute Bar" Rule to Claim Limitations Not Added by Amendment Is Unwarranted*

The Federal Circuit justified extending the absolute bar rule to the "through zero speed" limitation on the grounds that the "orbit frequency" limitation added by amendment was "not a completely separate limita-

tion, unrelated to sinusoidal variation." A-23. In other words, the Federal Circuit extended the absolute bar rule of *Festo* to a limitation already existing in the claim merely because the two limitations were related to one another (concluding that they should be treated as a single limitation) *Id.*

The "orbit frequency" limitation is distinct from the "sinusoidal" limitation. Varying the wheel speed at the rate of once per day is independent of whether the variation pattern is sinusoidal. Similarly, a sinusoidal rate schedule can have any frequency.

Moreover, as construed "sinusoidally" has two components: (1) a sine shaped curve and (2) "through zero speed." Even if the Federal Circuit is correct that the "orbit frequency" limitation is sufficiently related to the "sine shaped curve" limitation to treat the two limitations as a single limitation for purposes of *Festo*, the "through zero speed" limitation has no relationship whatsoever to the "orbit frequency" limitation. The period of a sine wave has nothing to do with whether the sine wave passes through zero. Conversely, locating a sine curve so that it passes through the zero speed has no relationship to its period. Any sine wave can pass through zero speed regardless of its period.

As pointed out in the various amicus briefs in *Festo*, the absolute bar rule is likely to have a devastating effect on the patent system and on the operations of the Patent and Trademark Office, and is unfair to existing patent holders (this case being a primary example) who made their bargain with the Patent and Trademark Office under a different set of rules. Therefore, if the "absolute bar" rule is to be retained, it should be applied narrowly, and limited to claim limitations actually added by amendment and not to other limitations which were part of the original claim.

CONCLUSION

The *Festo* absolute bar rule does not merely limit the statutory rights of patentees based on principles of equity, but constitutes judicial legislation. Moreover, there is no justification for extending the "absolute bar" rule in *Festo* to claim limitations which were part of the original claim and not added by amendment.

Date: September 21, 2001

Respectfully Submitted,

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APPENDIX

APPENDIX CONTENTS

Decision in Lockheed Martin v. Space Systems/ Loral, Inc dated April 30, 2001 . . . . . A-1

Order Denying Lockheed Martin's Petition For Rehearing *En Banc*, dated June 25, 2001 . A-25

Portion of the Prosecution History of the '772 Patent (appearing on pages A3663-A3664 of the Joint Appendix below) A-28

District Court Opinion In Lockheed Martin v. Space Systems/Loral, Inc. dated March 6, 2000 . . . . . A-30

Statutory Provisions A-45

United States Court of Appeals for the Federal Circuit

00-1310

LOCKHEED MARTIN CORPORATION,

Plaintiff-Appellant,

v.

SPACE SYSTEMS/LORAL, INC.,

Defendant-Appellee.

Robert B. Smith, Skadden, Arps, Slate, Meagher & Flom, LLP, of New York, New York, argued for plaintiff appellant. With him on the brief were Edward V. Filardi, of New York, and David W. Hansen, of Palo Alto, California.

Gregory R. Lyons, Wiley, Rein and Fielding, of Washington, DC, argued for defendant-appellee. With him on the brief were James H. Wallace, Jr., John B. Wyss. and Scott E. Bain.

Appealed from: U.S. District Court for the Northern District of California

Judge Susan Illston

United States Court of Appeals for the Federal Circuit

00-1310

LOCKHEED MARTIN CORPORATION,

Plaintiff-Appellant,

v.

SPACE SYSTEMS/LORAL, INC.,

Defendant-Appellee.

DECIDED: April 30, 2001

Before SCHALL, Circuit Judge, FRIEDMAN, Senior Circuit Judge, and GAJARSA, Circuit Judge.

GAJARSA, Circuit Judge.

DECISION

Lockheed Martin Corporation ("Lockheed") is the assignee of United States Patent 4,084,772 ("the '772 Patent"), which discloses an apparatus and method for steering a satellite. In 1995, Lockheed's predecessor, Martin Marietta Corporation, brought this patent infringement action against Space Systems/Loral, Inc. ("SSL"), alleging that certain SSL satellites infringe the '772 Patent. On March 7, 2000, the United States District Court for the Northern District of California ("District Court") determined that certain

limitations required by claim 1 of the '772 Patent are not present in SSL's Intelsat VII satellites either literally or under the doctrine of equivalents, and granted SSL's motion for summary judgment. Lockheed Martin Corp. v. Space Systems/Loral, Inc., 88 F. Supp. 2d 1095, 1102 (N.D. Cal. 2000).

Lockheed appeals that judgment.

For the reasons discussed below, we affirm.

I. BACKGROUND

The '772 Patent, entitled "Roll/Yaw Body Steering for Momentum Biased Spacecraft," claims a structure and method for reducing the pointing errors of a satellite that has entered into an inclined orbit by varying the speed of the satellite's transverse momentum wheel in a sinusoidal manner.

A. Introduction

A communications satellite typically orbits the earth in a geosynchronous equatorial orbit, circling the earth once every twenty-four hours in the equatorial plane. A geosynchronous orbit in the equatorial plane allows a satellite to maintain the same position relative to fixed points on the earth's surface, and is often referred to as "geostationary." A satellite in geostationary orbit, when viewed from the ground, appears to remain stationary in the sky. Therefore, a geostationary orbit enables a communications satellite to maintain a constant relationship with transmitters on earth. In addition to preserving a geosynchronous equatorial orbit, a communications satellite must also maintain a proper "attitude," or pointing direction, so that its antennae remain pointed at the desired target on the earth.

While in orbit, however, a satellite is subject to various destabilizing forces such as the gravitational effects of the sun and the moon. Such forces may cause a satellite to drift out of its equatorial orbit, into an "inclined" north-south orbit. A satellite in an inclined orbit may still orbit the earth in a geosynchronous manner (once every twenty-four hours), but may no longer appear stationary in the sky to an earthbound observer. The following diagram, Figure 2 of the '772 Patent specification, depicts an inclined orbit relative to an equatorial orbit:

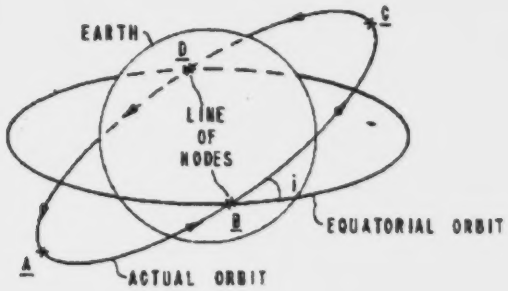

FIG. 2

Therefore, in an inclined orbit, the antennae of a communications satellite point north of the equator for half of the orbit and south of the equator for half of the orbit. Unless the satellite corrects for solar and lunar gravitational effects, the orbit of a geosynchronous satellite acquires an inclination at the rate of about 0.8 degrees annually.

The '772 Patent discloses a system for allowing a communications satellite to continue to operate effectively after entering an inclined orbit. It does so by changing the attitude, or pointing direction, of the satellite when the satellite is north and south of the equator. The method described by the '772 Patent rotates the satellite so that its antennae point north or south, and remain pointed at the same earth target over the course of twenty-four hours.

The attitude of satellites is described in terms of movement and rotation about three axes. The "pitch" axis lies in a north-south direction, the "roll" axis points in the direction of satellite orbital movement, and the "yaw" axis points to the center of the earth. In an inclined orbit, roll pointing error occurs when a satellite is north or south of the equator. There is no roll pointing error when a satellite crosses the equator twice each orbit (depicted above in diagram 2 at points B and D). Conversely, yaw pointing error is greatest when a satellite crosses the equator. There is no yaw pointing error when a
satellite is furthest north or south of the equator (depicted above in diagram 2 at points A and C).

The structure and method described by the '772 Patent rotates a satellite around its roll axis such that its antennae point to the south when the satellite is north of the equator, and point to the north when the satellite is south of the equator. In this manner, even though a satellite is moving north and south during its orbit, it remains pointed at the same earth target, and behaves as if it were still in geostationary orbit.

B. The '772 Patent Technology

Many communication satellites employ at least one "momentum" or "reaction" wheel centered on the pitch axis of a satellite ("pitch wheel") powered by an electric motor. A spinning momentum wheel creates angular momentum, or "stiffness," and opposes any satellite rotation about the roll or yaw axis. In other words, the spinning pitch wheel acts like a gyroscope, resists external forces, and keeps the pitch axis pointed in a north-south direction.

In addition to this resistance effect, momentum wheels also cause a satellite to rotate around its axes by taking advantage of the physical law of conservation of angular momentum. When a momentum wheel

increases speed in one direction, it causes the entire satellite to spin in the opposite direction along the same axis in order to conserve angular momentum. Thus, through careful control of momentum wheels centered on different axes, a proper satellite attitude can be maintained.

As discussed above, the invention described by the '772 Patent is a structure and method for spinning a second momentum wheel centered on a satellite's yaw axis. This wheel is referred to as the "yaw" wheel or "transverse" wheel. When the yaw wheel is accelerated, it creates angular momentum about the yaw axis. In response, the pitch wheel and the entire satellite must rotate about the roll axis in order to compensate and cancel the angular momentum created by the yaw wheel, thereby adjusting the north-south pointing direction of the antennae.

As described by the '772 Patent, the amount of north-south roll pointing attitude adjustment varies with the speed and spin direction of the yaw wheel. When the yaw wheel is not spinning, the satellite does not rotate about its roll axis. However, increased yaw wheel speed in one direction points the satellite to the north; increased yaw wheel speed in the other direction points the satellite to the south. In short, by varying the speed and direction of the yaw wheel, the satellite can be steered about its roll axis, adjusting and correcting for the north-south roll pointing errors described above.

The following diagram, Figure 3 of the '772 Patent specification, depicts the pointing direction resulting from this roll pointing attitude adjustment. As depicted, by rotating the satellite around its roll axis by Φ degrees, the satellite points at the equator:

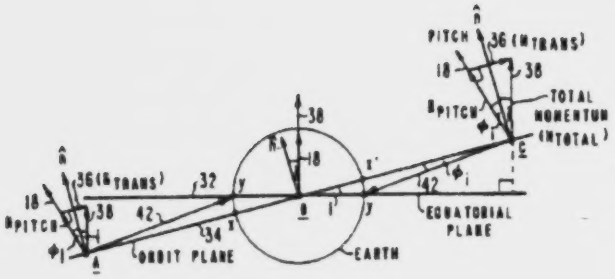

FIG. 3

The speed of the yaw wheel varies in a "sinusoidal" manner based on the orbital angle of inclination and the satellite's distance from the equator. That is, the yaw wheel spins slowly after the satellite crosses the equator, and spins at a maximum velocity when the satellite is furthest north or south in relation to the equator. As the satellite again approaches the equator, the yaw wheel slows down. As the satellite crosses the equator, the yaw wheel slows, stops, and reverses direction. The rate of change of yaw wheel spinning velocity is based on a sinusoidal variation over twenty-four hours.

The following diagram, Figure 4 of the '772 Patent specification, depicts a block diagram of the control system described by the '772 Patent:

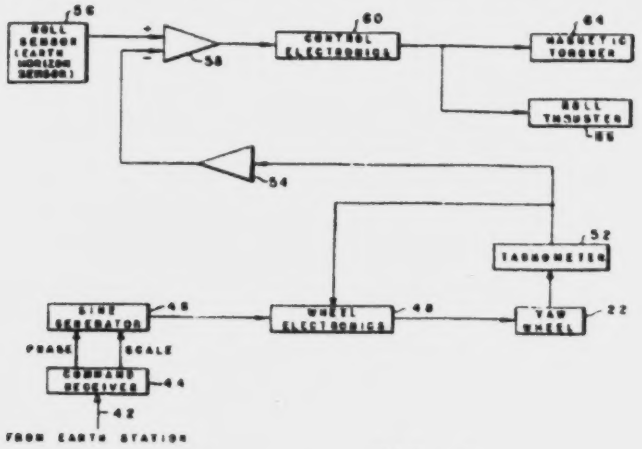

FIG. 4

The intentional north-south attitude adjustment described in the specification of the '772 Patent creates an additional control problem which must be resolved. Prior art satellites employed an "earth horizon" or "roll" sensor in order to keep the yaw axis pointed at the center of the earth during equatorial orbit. If the earth sensor described by the '772 Patent determines that the yaw axis is not pointed at the center of the earth, it activates the magnetic torquer (64) or roll thruster (66) in an attempt to reorient the satellite. During inclined orbit, however, the satellite is intentionally rotated about its roll axis. Unless the satellite is otherwise "fooled," the earth sensor would activate the magnetic torquer or roll thruster in an attempt to undo the intentional attitude adjustment.

The '772 Patent discloses a structure and method for "fooling" the earth sensor. A tachometer (52) generates a signal representing the speed and direction of the yaw wheel. This signal, representing the angle of intentional roll, is subtracted from the signal generated by the earth sensor (56) by a "summer" (58), and effectively "fools" the earth sensor from undoing the intentional attitude adjustment.

C. The '772 Patent Claims

Claim 1, the only independent claim in the '772 Patent at issue, reads as follows:

> A control system for an orbiting pitch momentum biased satellite, said satellite having a pitch, roll, and yaw axis, and wherein the momentum of said satellite is defined by a momentum vector, said satellite being adapted to be placed in an orbit defining a plane that is inclined relative to a plane containing a geo-synchronous orbit, said inclination inherently causing roll and yaw pointing

errors with respect to said geo-synchronous orbit, comprising:

a. a transverse wheel mounted parallel to said yaw axis and adapted for bi-directional rotation and varying speed,

b. means for rotating said wheel in accordance with a predetermined rate schedule which varies sinusoidally over the orbit at the orbital frequency of the satellite whereby the attitude of said satellite is offset in response to the effect of said rotating wheel by the direction of the pitch axis being changed with respect to said momentum vector, the direction of said pitch axis with respect to the inclined orbit normal varying sinusoidally at the orbital frequency to null said roll pointing error due to said orbit inclination, the momentum vector being maintained perpendicular to the plane of the geo-synchronous orbit to null said yaw pointing error due to said orbit inclination,

c. means responsive to said transverse wheel when rotating for generating a signal indicative of the speed and direction of said wheel,

d. attitude sensing means for generating an attitude error signal indicative of anerror in desired role attitude relative to said inclined orbit,

e. means responsive to said roll attitude error signal to orient said satellite by altering the inertial direction of said momentum vector,

f. said orientation means including means responsive to said wheel speed

and direction signal for modifying said attitude error signal to be non-responsive to said offset in attitude generative by said transverse wheel, said attitude offset being in addition to said roll attitude errors, said attitude offset due to said rotating transverse wheel having a predetermined relation to said inclination, whereby the yaw pointing errors due to said inclination are substantially reduced to zero by said momentum vector being repositioned to be perpendicular to the plane of said geo-synchronous orbit, and whereby the roll pointing errors due to said inclination are reduced substantially to zero by the rotation action of said transverse wheel.

(emphasis added)

The transverse wheel of limitation [a] is the yaw wheel discussed above. [1] The structure corresponding to the means recited in limitation [b] is the sine generator (46) and wheel electronics (48) noted in Figure 4 above. When the satellite enters inclined orbit, the sine generator commands the wheel electronics to rotate the yaw wheel (22) in a sinusoidal manner as described above. The structure corresponding to the means recited in limitation [c] is the tachometer (52) and difference amplifier (54). The "signal" referred to in limitation [c] represents the angle of intentional roll adjustment. The structure corresponding to the means recited in limitation [d] is the "earth horizon" or "roll" sensor (56) discussed above. The structure corresponding to the means recited in limitation [e] is the magnetic torquer (64) and/or the roll thruster (66) discussed above. Finally, the structure corresponding to limitation [f] is the "summer" (58) discussed above, which subtracts the angle of intentional roll from the roll pointing error signal generated by the earth sensor.

D. The Accused SSL Satellites

Lockheed asserts that SSL's Intelsat VII satellites infringe claim 1 of the '772 Patent. As discussed above, the '772 Patent describes a yaw wheel used in conjunction with a pitch wheel. The SSL satellites do not use a single pitch wheel centered on the pitch axis of the satellite. Instead, the SSL satellites use a pair of "V-Wheels" that straddle the pitch axis in a V-shape; each V-Wheel operates in a single direction. The attitude of the SSL satellites is controlled by altering the relative speed of the two V-Wheels ("V-Mode").

In addition to the V-Wheels, the SSL Intelsat VII satellites include a yaw wheel centered on the yaw axis of the satellite, referred to as an "L-Wheel." According to SSL, the L-Wheel is activated only when one of the two V-Wheels fails. The L-Wheel rotates in one direction if one V-Wheel fails ("L1-Mode"), and the other direction if the other V-Wheel fails ("L2-Mode"). However, the L-Wheel does not operate in both directions during an orbit. That is, the L-Wheel does not slow down to zero speed and reverse direction during an orbital period. Furthermore, while in operation, the L-Wheel never spins more slowly than a certain "bias" speed in order to offset the partial yaw momentum of the functioning V-Wheel.

The SSL satellites continuously monitor and correct roll and pitch pointing errors detected by the earth sensor. While operational, therefore, the speed of the L-Wheel changes continuously during orbit because it responds to actual errors detected while in orbit. The attitude control system of the SSL satellites is also designed to operate effectively during inclined orbit by compensating for the roll pointing error created by inclined orbit. During inclined orbit, the "roll bias generator" and "yaw momentum bias generator" of the SSL satellites vary the speed of the V-Wheels or the

L-Wheel, intentionally causing the satellite to point north or south.

The SSL satellites also include a mechanism to "fool" the satellite from attempting to correct the intentional roll pointing error detected by the earth sensor. As discussed above, if the SSL satellite earth sensor detects a roll pointing error while the L-Wheel is operational, the speed of the L-Wheel changes in order to correct the detected error. However, when the satellite is intentionally rolled during an inclined orbit, the angle of intentional roll is summed with the roll error output signal of the earth sensor, and the satellite is effectively "fooled" from correcting for the intentional attitude adjustment.

E. Procedural Background

On March 10, 1999, the District Court held a Markman hearing in order to construe the phrases "adapted for bi-directional rotation" and "varies sinusoidally" contained in limitations [a] and [b] of claim 1 of the '772 Patent. The District Court subsequently issued its claim construction order regarding these phrases. See Lockheed Martin Corp. v. Space Systems/Loral, Inc., No. C-95-3530-SI, slip. op. (N.D. Cal. Mar. 12, 1999). Of particular importance, the District Court concluded that the phrase "varies sinusoidally" used in limitation [b] means "a sine-shaped variation that passes through zero." Id. at 8-9. Relying on intrinsic evidence alone, it ruled that the phrase means "variation that passes through zero and changes direction, or sign." Id. at 9. Furthermore, the District Court "decline[d] to construe 'varies sinusoidally' to include variations that do not pass through zero," and determined that additional inputs are "more appropriately addressed under the doctrine of equivalents." Id. at 11-12.

On March 7, 2000, the District Court granted summary judgment of non-infringement for SSL. Lockheed, 88 F. Supp. 2d at 1102. First, the District Court ruled that the SSL satellites do not literally infringe claim 1 of the '772 Patent. Consistent with its construction of the phrase "varies sinusoidally," the District Court reasoned that, "[i]t is undisputed that the speed of the accused reaction wheel does not slow to zero and reverse direction." Id. at 1099. Furthermore, the District Court stated that, "[i]t is also undisputed that the speed of the Intelsat VII reaction wheel varies according to a rate schedule that is not purely sinusoidal, providing an additional basis for finding that this limitation is not literally met." Id.

The District Court also ruled that the SSL satellites did not infringe under the doctrine of equivalents. The District Court applied the "function-way-result" analysis to determine the appropriate scope of limitation [b] under the doctrine of equivalents. Id. (referencing Warner-Jenkinson Co., Inc. v. Hilton Davis Chem. Co., 520 U.S. 17, 40, 41 USPQ2d 1865, 1875 (1997)). Under the doctrine of equivalents, a finding of infringement is appropriate if each element of the accused device performs substantially the same function, in substantially the same way, to achieve substantially the same result. Id. The District Court determined that the function of limitation [b] is a means for "rotating said wheel," by way of using a "predetermined rate schedule which varies sinusoidally," with the result that "the attitude of said satellite is offset . . . to null said roll pointing error due to said orbit inclination." Lockheed, 88 F. Supp. 2d at 1100.

The District Court then ruled that there was a factual dispute as to whether the function and result of the accused SSL L-Wheel are substantially the same as that claimed by limitation [b] of claim 1 of the '772 Patent. However, based on its prior claim construction, the District Court noted that, "it is undisputed that the

transverse wheel of the Intelsat VII does not pass through zero twice per orbit." Id. at 1101. Therefore, the District Court granted summary judgment of non-infringement for SSL because it determined that the "way" the SSL L-Wheel operated was not substantially similar as that claimed in the '772 Patent. Id. The District Court held that any other theory of equivalence would vitiate the claim limitation "varies sinusoidally" recited in limitation [b]. Id. (citing Tronzo v. Biomet, Inc., 156 F.3d 1154, 1160, 47 USPQ2d 1829, 1834 (Fed. Cir. 1998)).

As an additional basis for granting summary judgment, the District Court ruled the SSL satellites do not infringe limitation [f] of claim 1 of the '772 Patent, either literally or through the doctrine of equivalents. Id. at 1102. The District Court stated that, "[t]he limitation requiring element [f] to be responsive to a wheel direction signal is simply not met." Id.

F. Arguments on Appeal

Lockheed does not challenge the District Court's claim construction that "varies sinusoidally" means "a variation in a sine-shaped curve that passes through zero." Accordingly, Lockheed concedes that there can be no literal infringement of limitation [b]. However, Lockheed posits that the grant of summary judgment was improper because a factual dispute exists as to whether the SSL satellites contain an equivalent to limitation [b]. Lockheed relies on the testimony of its expert witness, Dr. Alfriend, for the proposition that the SSL Intelsat VII satellites have a means to rotate their L-Wheel purely sinusoidally. Moreover, Lockheed disagrees with the construction of the phrase "varies sinusoidally" insomuch as it precludes additional, insubstantial inputs.

Finally, Lockheed maintains that the District Court failed to conduct a complete infringement analy-

sis as to limitation [f]. Although the District Court examined the SSL tachometers and ground-based computer processors, Lockheed argues that the District Court failed to consider whether the SSL "roll bias generator" satisfies the requirements of limitation [f].

II. STANDARD OF REVIEW

We review the grant of a motion for summary judgment de novo, drawing all reasonable factual inferences in favor of the non-moving party. Anderson v. Liberty Lobby, Inc., 477 U.S. 242, 255 (1986); Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 234 F.3d 558, 585, 56 USPQ2d 1865, 1886 (Fed. Cir. 2000) (en banc). Summary judgment "shall be rendered forthwith if the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to a judgment as a matter of law." Fed. R. Civ. P. 56(c); Newbanks v. Cent. Gulf Lines, Inc., 64 F. Supp. 2d 1, 4 (D. Mass. 1999).

The determination of infringement is a two-step process. First, the court construes the claims to correctly determine the scope of the claims. Second, it compares the properly construed claims to the accused device. Cybor Corp. v. FAS Techs., Inc., 138 F.3d 1448, 1454, 46 USPQ2d 1169, 1172 (Fed. Cir. 1998) (en banc). Claim construction is a matter of law that we review de novo, without deference to the District Court. Id. at 1456, 46 USPQ2d at 1172-73. Hence, claim construction of a "means plus function" limitation, as contemplated by 35 U.S.C. § 112 ¶ 6 (1994 ed., Supp. V), is also a question of law to be reviewed de novo. Chiuminatta Concrete Concepts, Inc. v. Cardinal Indus., Inc., 145 F.3d 1303, 1308, 46 USPQ2d 1752, 1755-56 (Fed. Cir. 1998).

However, a determination of infringement, both literal and under the doctrine of equivalents, is a question of fact. Insituform Techs., Inc. v. Cat Contracting, Inc., 161 F.3d 688, 692, 48 USPQ2d 1610, 1614 (Fed. Cir. 1998). Thus, viewing the facts and inferences in the light most favorable to Lockheed, summary judgment is proper only if "no reasonable jury could return a verdict for the nonmoving party." Anderson, 477 U.S. at 255. Finally, the determination of infringement under the doctrine of equivalents is limited by two primary legal doctrines: (1) prosecution history estoppel and (2) the "all elements" rule. The application of these legal limitations is reviewed by this court de novo. Festo, 234 F.3d at 586, 56 USPQ2d at 1886.

III. DISCUSSION

1. Claim Construction: Limitation [b]

Both parties agree that limitation [b] of claim 1 of the '772 Patent is written as a "means-plus-function" claim limitation. A means-plus-function limitation recites a function to be performed rather than definite structure or materials for performing that function. Chiuminatta, 145 F.3d at 1307, 46 USPQ2d at 1755. Such a limitation must be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof. 35 U.S.C. § 112 ¶ 6.

The first step in analyzing a claim written in means-plus-function form is to identify the claimed function. Chiuminatta, 145 F.3d at 1308, 46 USPQ2d at 1756. The District Court determined that limitation [b] recites a means having the function of "rotating said wheel." Lockheed, 88 F. Supp. 2d at 1100. SSL maintains that the District Court improperly broadened the function of limitation [b] by "reading out" the remaining claim limitations. We agree with SSL.

Once a court establishes that a means-plus-function limitation is at issue, it must identify and construe that limitation, thereby determining what the claimed function is, and what structures disclosed in the written description correspond to the "means" for performing that function. The phrase "means for" generally invokes 35 U.S.C. § 112 ¶ 6, and is typically followed by the recited function and claim limitations. Greenberg v. Ethicon Endo-Surgery, Inc., 91 F.3d 1580, 1584, 39 USPQ2d 1783, 1786-87 (Fed. Cir. 1996). In identifying the function of a means-plus-function claim, a claimed function may not be improperly narrowed or limited beyond the scope of the claim language. Micro Chem. Inc. v. Great Plains Chem. Co., 194 F.3d 1250, 1258, 52 USPQ2d 1258, 1263 (Fed. Cir. 1999). Conversely, neither may the function be improperly broadened by ignoring the clear limitations contained in the claim language. The function of a "means plus function" claim must be construed to include the limitations contained in the claim language.

In this case, the District Court erred by improperly broadening the scope of the claimed function by "reading out" the limitations contained in the claim language. The function of limitation [b] is properly identified as "rotating said wheel in accordance with a predetermined rate schedule which varies sinusoidally over the orbit at the orbital frequency of the satellite." The function is properly identified as the language after the "means for" clause and before the "whereby" clause, because a whereby clause that merely states the result of the limitations in the claim adds nothing to the substance of the claim. Texas Instruments Inc. v. United States Int'l Trade Comm'n, 988 F.2d 1165, 1172, 26 USPQ2d 1018, 1023-24 (Fed. Cir. 1993).

Having identified the function of limitation [b], we next construe the meaning of the words used to describe the claimed function, using ordinary princi-

ples of claim construction. The District Court construed the phrase "varies sinusoidally" to mean "a variation in a sine-shaped curve that passes through zero." Lockheed, 88 F. Supp. 2d at 1099. In its claim construction order, the District Court explained that the "rate" or "speed" of the wheel itself must pass through zero. See Lockheed, No. C-95-3530-SI, slip. op. at 8-10. The District Court determined that this construction "is consistent with the other limitations in the claims themselves regarding the capacity of the transverse momentum wheel to accelerate in one direction, slow to zero, and rotate in the opposite direction." Id.

Neither party disputes the District Court's construction of this phrase, and we find no fault in the District Court's careful analysis. The meaning of the remaining language of limitation [b] is clear from the plain language of the claim and is consistent with the intrinsic evidence. See Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1582-83, 39 USPQ2d 1573, 1576-77 (Fed. Cir. 1996). The wheel must rotate in accordance with a "predetermined rate schedule." According to the written description, the rate schedule is produced by the sine generator and is dependent on the orbital period as well as the angle of orbital inclination. '772 Patent, col. 7, ll. 28-64. It is undisputed that the "orbital frequency of the satellite" is twenty-four hours; the written description specifically states that the pointing errors change "at the orbital frequency, which for a spacecraft in a synchronous altitude orbit, is one day." '772 Patent, col. 4, l. 29. Furthermore, it is clear from the written description that the rate schedule is "predetermined" insomuch as the sine generator produces a sine wave with an amplitude that changes "on a continuous basis" and that is "related to the inclination deviation" angle. '772 Patent, col. 7, l. 28 – col. 8, l. 33.

After identifying the function of the "means plus function" limitation and construing the meaning of the claim language, we look next to the written description to identify the structure corresponding to the function. Micro Chemical, 194 F.3d at 1258, 52 USPQ2d at 1263. It is undisputed that the structures disclosed in the '772 Patent which correspond to the function of limitation [b] are the sine generator and wheel electronics noted in Figure 4 above. As discussed, the sine generator operates by producing a sine wave signal whose amplitude varies based on the orbital angle of inclination. The wheel electronics are responsive to signals from the sine generator and the tachometer, and generate a signal to the yaw wheel such that the wheel generates a sinusoidal variation of momentum. '772 Patent, col. 8, ll. 15-25.

2. Infringement: Limitation [b]

Literal infringement of a § 112 ¶ 6 claim requires that the relevant structure in the accused device perform the identical function recited in the claim and be identical or equivalent to the corresponding structure in the specification. WMS Gaming, Inc. v. Int'l Game Tech., 184 F.3d 1339, 1347, 1350, 51 USPQ2d 1385, 1390, 1392-93 (Fed. Cir. 1999); Odetics, Inc. v. Storage Tech. Corp., 185 F.3d 1259, 1267, 51 USPQ2d 1225, 1229 (Fed. Cir. 1999). Lockheed concedes that there can be no literal infringement of limitation [b] because the SSL satellite L-Wheel rotates about a non-zero bias speed. That is, the SSL L-Wheel does not perform the identical function of limitation [b] as properly construed. However, Lockheed contends that a factual dispute exists as to whether the SSL Intelsat VII satellites meet the requirements of limitation [b] under the doctrine of equivalents. An accused structure that does not literally infringe a "means plus function" claim may nevertheless infringe under the doctrine of equiva-

lents. See Kemco Sales, Inc. v. Control Papers Co., 208 F.3d 1352, 1364, 54 USPQ2d 1308, 1315-16 (Fed. Cir. 2000). Specifically, Lockheed asserts that the testimony of its expert, Dr. Alfriend, raises a genuine issue of material fact as to whether the SSL satellites contain an equivalent to the claimed means for rotating the transverse wheel about zero speed.

Lockheed relies on the testimony of its expert, Dr. Alfriend, for the proposition that the SSL satellite L-Wheel "varies according to a sine-shaped curve that passes through zero and changes direction twice per day." According to Dr. Alfriend, "[t]he only difference is that, in the Intelsat VII satellite, when the sinusoidal input is added, the yaw wheel is already spinning at a bias speed, whereas in the '772 exemplary embodiment the wheel is initially stationary." Furthermore, Dr. Alfriend posits that the SSL satellite "has the capability to be operated in inclined orbit with a purely sinusoidal roll bias if desired." Even when other inputs are used, Dr. Alfriend states that, "the bias signal would be predominantly sinusoidal."

It is true that an accused device may infringe under the doctrine of equivalents if each element performs substantially the same function, in substantially the same way, to achieve substantially the same result. Warner-Jenkinson, 520 U.S. at 40, 41 USPQ2d at 1875. However, this court must first determine whether the scope of the doctrine of equivalents, as applied to the claim limitations of limitation [b], has been narrowed by the legal doctrine of prosecution history estoppel or proscribed by the "all elements" rule. Festo, 234 F.3d at 586, 56 USPQ2d at 1886. These determinations are made de novo. Id.

The scope of the doctrine of equivalents may be limited by prosecution history because a patentee cannot recapture subject matter surrendered during the prosecution of the patent. Warner Jenkinson, 520 U.S. at 31-32, 41 USPQ2d at 1872-73. Estoppel may

arise by amendments made to overcome prior art rejections, or by argument made to secure allowance of a claim. Festo, 234 F.3d at 586, 56 USPQ2d at 1886. The first step in a prosecution history estoppel analysis is to determine which claim limitations are alleged to be met by equivalents. Id. Lockheed argues that limitation [b] is met by equivalents because the rotation of the SSL satellite L-Wheel is substantially the same as the sinusoidal variation described by the '772 Patent.

This court must next determine whether an amendment was made concerning the limitation at issue during the prosecution of the patent. Festo, 234 F.3d at 586, 56 USPQ2d at 1886. If the claim limitation at issue was amended, this court must determine whether the amendment narrowed the literal scope of the claim. Id. If so, prosecution history estoppel will bar the application of the doctrine of equivalents to the claim limitation, unless the patent holder establishes that the amendment was made for a purpose unrelated to patentability. Id.

In this case, limitation [b] was amended twice during prosecution of the patent. As originally filed, the pertinent language of limitation [b] stated, "means for rotating said wheel in accordance with a predetermined sinusoidal variation." The examiner first rejected the application on obviousness grounds, based on four prior art references. In response, the applicant amended limitation [b] to state, "means for rotating said wheel in accordance with a predetermined rate schedule which varies sinusoidally over the orbit." (added language underlined). Thus, the phrase "sinusoidal variation" was changed to "rate schedule which varies sinusoidally over the orbit." The examiner again rejected the claim. The applicant again amended the claim by adding the phrase "at the orbital frequency of the satellite" such that limitation [b] appeared as it ultimately issued.

Lockheed argues that the two amendments to limitation [b] "had nothing to do with sinusoidal operation about zero speed, or with purely sinusoidal operation." Instead, Lockheed asserts that the amendments were made to distinguish the period of sinusoidal variation described in the prior references. Specifically, Lockheed asserts that the claim was rejected because the prior references disclosed sinusoidal variation over a period of "nutation" (several minutes). Lockheed argues, therefore, that the amendments merely distinguished that the period of sinusoidal variation disclosed in limitation [b] occurs "over the orbit at the orbital frequency of the satellite" (twenty-four hours).

In short, Lockheed argues that this court should follow the "flexible bar" approach in determining the proper scope of equivalents. Lockheed asserts that the amendments to limitation [b] were directed only at the period of sinusoidal variation. Therefore, Lockheed reasons that prosecution history estoppel does not act as a complete bar to the application of the doctrine of equivalents as to the sinusoidal variation claimed in limitation [b]. However, our decision in Festo comprehensively and explicitly rejects such a "flexible bar" approach. 234 F.3d at 574-78, 56 USPQ2d at 1877-80. We reasoned that the notice function of patent claims has become paramount, and the need for certainty as to the scope of patent protection has been emphasized. Id. By rejecting the flexible bar approach, we enforce the disclaimer effect of a narrowing claim amendment, and best serve the notice and definitional function of patent claims. Id. In short, we held that, "prosecution history estoppel acts as a complete bar to the application of the doctrine of equivalents when an amendment has narrowed the scope of a claim for a reason related to patentability." Id. at 574, 56 USPQ2d at 1877 (emphasis added).

In this case, even Lockheed admits that, "the two amendments to claim element [b] were to specify

more narrowly the period of the sinusoidal variation, i.e., to specify that the sinusoidal variation occurred once per day." (emphasis in original). Therefore, the entire claim limitation [b] was amended to define further the characteristics of the sinusoidal variation. The first amendment wholly replaced the phrase "sinusoidal variation" with the language "rate schedule which varies sinusoidally over the orbit." This amendment illustrates that the entire limitation of limitation [b] was changed - not that a completely separate limitation, unrelated to sinusoidal variation, was added. Thus, the amendment narrowed the literal scope of limitation [b].

"No scope of equivalents can be afforded to a claim element that was narrowed because of patentability concerns." Festo, 234 F.3d at 576, 56 USPQ2d at 1878. As discussed, the amendments narrowed the literal scope of limitation [b]. Additionally, it is undisputed that the amendments were made for purposes of patentability. Therefore, because the applicant limited the scope of limitation [b] to "a predetermined rate schedule which varies sinusoidally over the orbit," there is no range of equivalents available to show infringement of limitation [b]. Thus, "prosecution history estoppel [bars] the application of the doctrine of equivalents" to limitation [b]. Festo, 234 F.3d at 586, 56 USPQ2d at 1886. Moreover, because Lockheed's claim of infringement must fail, we need not discuss the all elements rule, nor examine whether the SSL satellites meet the limitations of limitation [f].

IV. CONCLUSION

For the reasons discussed, the District Court's grant of summary judgment of non-infringement in favor of SSL is

AFFIRMED.
COSTS

No costs.

[1] The District Court and the parties use the term "element" to refer to subcategories of claim language. However, "[i]t is preferable to use the term 'limitation' when referring to claim language and the term 'element' when referring to the accused device." Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 234 F.3d 558, 564 n.1, 56 USPQ2d 1865, 1868 (Fed. Cir. 2000). We, therefore, use the term "limitation" in this opinion.

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

00-1310

LOCKHEED MARTIN CORPORATION,

Plaintiff-Appellant,

v.

SPACE SYSTEMS/LORAL, INC.,

Defendant-Appellee,

ORDER

United States Court of Appeals for the Federal Circuit

ORDER

A petition for rehearing en banc having been filed by the APPELLANT, and a response thereto having been invited by the court and filed by the APPELLEE, and the matter having first been referred as a petition for rehearing to the panel that heard the appeal, and thereafter the petition for rehearing en banc and response having been referred to the circuit judges who are in regular active service,

UPON CONSIDERATION THEREOF, it is

ORDERED that the petition for rehearing be, and the same hereby is, DENIED and it is further

ORDERED that the petition for rehearing en banc be, and the same hereby is, DENIED.

The mandate of the court will issue on July 2, 2001.

Circuit Judge CLEVENGER did not participate in the vote.

FOR THE COURT
s/_____
Jan Horbaly
Clerk

Dated: June 25, 2001

FILED
U.S. Court of Appeals For
The Federal Circuit
June 25, 2001
Jan Horbaly
Clerk

cc: Edward V. Filardi
James H. Wallace, Jr.

LOCKHEED MARTIN V SPACE SYSTEMS, 00-1310
(DCT - 95-CV-3530)

Note: Pursuant to Fed. Cir. R. 47.6, this order is not citable as precedent. It is a public record

REMARKS

The application has been amended by amending claims 1 and 7 to define applicant's invention to distinguish clearly from the cited references. . . .

Claims 1 and 7 are amended to make clear that applicant's invention provides for a transverse wheel (22) that is mounted parallel to the yaw axis and is operated at the orbital period of the satellite, the orbital frequency for a geosynchronous satellite being one day. This operation of the transverse wheel is arranged to compensate for the error that is inherent due to the inclination of the satellite orbit by offsetting the pitch axis. The inclination error being developed at a sinusoidal rate, the claim recites that the wheel is rotated according to a sinusoidal rate over the orbit at the orbital frequency of the satellite. The Perkel, et al. wheel (20) operates in response to closed loop control action at the nutation frequency (column 2, line 52) and as such is incapable of correcting thereby the

pointing errors, noting that "nutation" errors are not "pointing errors. The nutation effects are undesirable transverse body rates causing the pitch axis to manifest the well known coning or wobble effects. The nutation of a satellite is the oscillation of the pitch axis with respect to an inertially fixed momentum vector. Applicant's invention is not addressed to the problem of damping or correcting nutation. Applicant's invention is directed to the problem of correcting for inherent pointing errors developed by a satellite that is orbiting in a plane that is inclined to a geo-synchronous orbit.

LOCKHEED MARTIN CORP.,
Plaintiff,
v.
SPACE SYSTEMS/LORAL,
Defendant.
No. C 95-3530 SI

UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF CALIFORNIA

88 F. Supp. 2d 1095; 2000 U.S. Dist. LEXIS 3166

March 6, 2000, Decided
March 7, 2000, Filed; March 10, 2000, Entered in Civil Docket

DISPOSITION: [**1] Defendant's motion for summary judgment GRANTED. Judgment entered in favor of defendant.

OPINIONBY: SUSAN ILLSTON

OPINION: [*1096] ORDER GRANTING DEFENDANT'S MOTION FOR SUMMARY JUDGMENT OF NON-INFRINGEMENT OF U.S. PATENT NO. *4,084,772*

On February 25, 2000, the Court heard argument on defendant's motion for summary judgment of non-infringement of U.S. Patent No. *4,084,772*. Having considered the arguments of counsel and the papers submitted, and for the reasons set out below, the Court hereby GRANTS defendant's motion for summary judgment.

BACKGROUND

Plaintiff Lockheed Martin Corporation ("Lockheed") alleges infringement of United States Patent No. *4,084,772* (the " *'772* patent"), entitled "Roll/Yaw Body Steering For Momentum Biased Spacecraft," by defendant Space Systems/Loral, Inc. ("SSL"). The *'772* patent claims a system and method for reducing the pointing errors of a satellite that has entered into an inclined orbit by varying[**3] the speed of the satellite's transverse momentum wheel in a sinusoidal manner. Although Lockheed had alleged that ten different types of SSL satellites infringe the *'772* patent, it now concedes that six of these types do not infringe. Because the four remaining types of satellites all use the same momentum wheel configuration and inclined orbit software, the focus of this action has been narrowed to the first of these four, which is the Intelsat VII satellite.

Most communications satellites operate optimally in a geosynchronous, equatorial orbit, circling the earth once every 24 hours in the equatorial plane and thus remaining in the same position relative to the earth's surface. Such positioning allows for a consistent relationship between the satellite and a transmitter on earth, from which the satellite receives and relays radio signals. It is essential that a satellite maintain a proper attitude, or orientation, so that its communication devices (e.g., antennae) are properly directed [*1097] towards the earth. Satellites are subject to various destabilizing forces, such as gravitational effects from the sun and moon, or even the force exerted by light from the sun, which all serve to[**4] disturb ideal orbit and attitude. For example, the orbit of a geostationary satellite acquires an inclination at the rate of about 0.8 degrees a year due to the gravitational forces of the sun and moon. These forces cause the satellite to drift out of its orbit in the equatorial plane and into an inclined orbit, which in turn causes a periodic attitude error.

To maintain a proper attitude, most satellites employ at least one momentum wheel powered by an electric motor. A spinning momentum wheel creates angular momentum, or "stiffness," which provides a torquing force that alters the attitude of the satellite. Thus, by careful control, a proper attitude for the satellite can be maintained. The method and apparatus claimed by the *'772* patent provide for a satellite momentum wheel that is used to correct for the natural periodic pointing error of inclined orbit satellites. This is accomplished by altering the speed of the wheel, which in turn adjusts satellite attitude and counteracts the attitude error introduced by the inclined orbit.

Case History

On August 19, 1998 the Court issued its Order Partially Granting Defendant's Motion for Summary Judgment, which construed a[**5] disputed claim term, granted SSL's motion for summary judgment of non-infringement of claim 7, and denied SSL's motion for summary judgment of non-infringement of claims 1-6. The term "bi-directional rotation," which is found in claim 1, was construed to require that the rotating transverse wheel accelerate in one direction, slow down to a speed of zero, and then rotate in the opposite direction.

On March 11, 1999 the Court issued its Claim Construction Order, which construed another disputed claim term and clarified other contested claim construction matters. The term "varies sinusoidally," which is also found in claim 1, was construed to mean a variation in a sine-shaped curve that passes through zero. The Court also found that this term inherently excludes any other added components that might cause the transverse wheel speed not to pass through zero. The Court's earlier construction of "bi-directional rota-

tion" was reaffirmed, and the Court declined to adopt an additional proposed limitation that the wheel be capable of "operating through zero in a controllable manner."

After subsequent discovery, defendant SSL now moves again for summary judgment of non-infringement. Because[**6] the Court has already held that claim 7 is not infringed, and because claims 2-6 are dependent upon claim 1, a determination of non-infringement of claim 1 would be dispositive. The issues presently before this Court are whether elements (b) and (f) of claim 1 may be found in the accused devices either literally or through the doctrine of equivalents.

LEGAL STANDARD

1. Summary Judgment

Noninfringement is an issue of fact. See *Suntiger, Inc. v. Scientific Research Funding Group, 189 F.3d 1327, 1335 (Fed. Cir. 1999)*. A motion for summary judgment may be granted when "the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to a judgment as a matter of law." Fed. R. Civ. P. 56(c). See also *Celotex Corp. v. Catrett, 477 U.S. 317, 322, 106 S. Ct. 2548, 2552, 91 L. Ed. 2d 265 (1986)*. Summary judgment is as appropriate in a patent case as in any other case in which no genuine issue of material fact remains. See *Barmag Barmer Maschinenfabrik AG v. Murata Mach., Ltd., 731 F.2d 831, 835 (Fed. Cir. 1984)*. [**7]Procedural matters not unique to patent law are decided by applying the law of the relevant regional circuit. [*1098] See

Transmatic, Inc. v. Gulton Indus., Inc., 53 F.3d 1270, 1278 (Fed. Cir. 1995).

It is initially the burden of the party moving for summary judgment to establish that there is no genuine issue of material fact and that it is therefore entitled to judgment as a matter of law. See *British Airways Bd. v. Boeing Co., 585 F.2d 946, 951 (9th Cir. 1978).* If the moving party meets its initial burden of identifying for the court those portions of the materials on file that it believes demonstrate the absence of any genuine issues of material fact, then the burden of production shifts so that the non-moving party must set forth specific facts showing that there is a genuine issue for trial. See *T.W. Elec. Serv., Inc. v. Pacific Elec. Contractors Ass'n, 809 F.2d 626, 630 (9th Cir. 1987)* (citing *Celotex, 477 U.S. at 324, 106 S. Ct. at 2553).* To carry this burden, the non-moving party must do more than simply show that there is some metaphysical doubt as to the material facts. See *Matsushita Elec. Indus. Co., Ltd. v. Zenith Radio Corp., 475 U.S. 574, 586, 106 S. Ct. 1348, 1356, 89 L. Ed. 2d 538 (1986).*[**8] The mere existence of a scintilla of evidence is insufficient; there must be evidence on which the jury could reasonably find for the non-moving party. See *Anderson v. Liberty Lobby, Inc., 477 U.S. 242, 252, 106 S. Ct. 2505, 2512, 91 L. Ed. 2d 202 (1986).* Evidence that "is merely colorable, or is not significantly probative," is not sufficient to avoid summary judgment. See *id. at 249-50.*

Conversely, summary judgment cannot be granted where a genuine dispute exists as to any material fact. See Fed. R. Civ. Proc. 56(c). A material fact is one which might affect the outcome of the case under the applicable law. See *Anderson, 477 U.S. at 248.* A dispute about a material fact is genuine if a reasonable jury could return a verdict for the non-moving party.

See id. In judging evidence at the summary judgment stage, a court cannot make credibility determinations or weigh conflicting evidence, and must draw all inferences in the light most favorable to the nonmoving party. See *T.W. Electric, 809 F.2d 626 at 630-31* (citing *Matsushita, 475 U.S. at 587, 106 S. Ct. at 1356).* Conclusory, speculative testimony and arguments in[**9] moving papers are insufficient to raise genuine issues of fact and defeat summary judgment. See *Thornhill Publ'g Co., Inc. v. GTE Corp., 594 F.2d 730, 738 (9th Cir. 1979).*

2. Doctrine of Equivalents

Under the "doctrine of equivalents," a product that does not literally infringe upon the express terms of a patent claim may still infringe if there is "equivalence" between the accused product and the patent claim. See *Warner-Jenkinson Co., Inc. v. Hilton Davis Chem. Co., 520 U.S. 17, 20, 117 S. Ct. 1040, 1045, 137 L. Ed. 2d 146 (1997); Graver Tank & Mfg. Co. v. Linde Air Products Co., 339 U.S. 605, 609, 70 S. Ct. 854, 94 L. Ed. 1097 (1950).* This doctrine allows for a finding of infringement where differences between a patented device and an accused product are insubstantial, and an accused device has traditionally been held to infringe if it performs substantially the same function in substantially the same way to achieve substantially the same result as the claimed invention. See *Graver Tank, 70 S. Ct. at 856.*

Application of the doctrine, however, has recently been limited by the Supreme Court to exclude broad comparisons that would eliminate[**10] any individual claim element. See *Warner-Jenkinson, 117 S. Ct. at 1049.* "Each element contained in a patent claim is deemed material to defining the scope of the patented

invention, and thus the doctrine of equivalents must be applied to individual elements of the claim, not to the invention as a whole." Id. Whether a substitute element in an accused device matches the function, way, and result or is substantially different from a corresponding claimed element is determined by an analyzing the role played by each element in the context of the specific patent claim. Id. at 1054. "If a theory of equivalence would vitiate a [*1099]claim limitation, however, then there can be no infringement under the doctrine of equivalents as a matter of law." *Tronzo v. Biomet, Inc., 156 F.3d 1154, 1160 (Fed. Cir. 1998)* (citing *Warner-Jenkinson, 117 S. Ct. at 1049, 1053 n.8).*

DISCUSSION

The following facts are undisputed. The accused Intelsat VII is a pitch-momentum biased inclined orbit satellite that uses momentum wheels to control satellite attitude. In normal operation ("V mode"), the Intelsat VII rotates two momentum wheels ("V wheels")[**11] in opposite directions in a V-formation about the pitch axis of the satellite. These wheels rotate at high speed according to a predetermined rate schedule and do not change direction. A third wheel ("L wheel" or "reaction wheel") does not rotate when the satellite operates in V mode, and serves as a backup wheel in the event that either V wheel fails. Should one V wheel fail, the L wheel would then rotate in a direction opposite that of the remaining V wheel. The L wheel is thus capable of rotating in either direction, with the two modes designated as L1 and L2. The axis of this reaction (L) wheel is mounted parallel to the yaw axis, and is thereby a "transverse wheel" as that term is used in the '772 patent, rendering the reaction wheel the wheel of interest in an infringement analysis.

1. "varies sinusoidally"

Paragraph (b) of claim 1 of the '772 patent calls for a:

means for rotating said [transverse] wheel in accordance with a predetermined rate schedule which varies sinusoidally over the orbit at the orbital frequency of the satellite whereby the attitude of said satellite is offset in response to the effect of said rotating wheel by the direction of[**12] the pitch axis being changed with respect to said momentum vector, the direction of said pitch axis with respect to the inclined orbit normal varying sinusoidally at the orbital frequency to null said roll pointing error due to said orbit inclination, the momentum vector being maintained perpendicular to the plane of the geo-synchronous orbit to null said yaw pointing error due to said orbit inclination,

'772 patent at col. 10:14-27 (emphasis added). In its earlier Claim Construction Order, the Court construed "varies sinusoidally" to mean a variation in a sine-shaped curve that passes through zero, and excluded any other components that might cause the transverse wheel speed not to pass through zero. It is undisputed that the speed of the accused reaction wheel does not slow to zero and reverse direction as required by the Court's earlier construction of the term "varies sinusoidally." Consistent with its earlier construction of "varies sinusoidally," and despite Lockheed's invitation to reinterpret this term, the Court finds that this limitation is not literally met. It is also undisputed that the speed of the Intelsat VII reaction wheel varies according to a rate schedule[**13] that is not purely sinusoidal, providing an additional basis for finding that this limitation is not literally met. Accordingly, the Court concludes as a matter of law that the Intelsat VII does not literally infringe the '772 patent. This leaves only the

matter of possible infringement through the doctrine of equivalents.

SSL points to this Court's prior orders and contends that the Court's rejection of any variation on "varies sinusoidally" bars any equivalence finding, because such a finding would vitiate this limitation and thereby violate the "all elements" rule of Warner-Jenkinson. SSL further argues that Lockheed has not shown that the variations between the claimed invention and the Intelsat VII are insubstantial. It asserts that the "function" of the claimed "means for rotating" is to provide satellite attitude control, that the "way" is to generate a signal to alter the wheel speed such that it moves sinusoidally and passes through zero twice per orbit, and that the "result" is the nulling of roll pointing error. SSL then argues that the Intelsat VII reaction wheel "functions" as a backup, [*1100] that pointing accuracy is maintained by "way" of a complex equation, and that[**14] the "result" is greater pointing accuracy and fuel savings. Finally, SSL points out that its approach is the subject of a later patent, and argues that this demonstrates the substantial and patentable differences between the accused device and the claimed invention.

Lockheed argues that the differences between the Intelsat VII and the claimed invention are insubstantial, and proposes different definitions for "function," "way," and "result." Lockheed defines "function" as introducing a yaw momentum that varies sinusoidally about zero over the course of the orbit; "way" as sinusoidally varying the rate of a yaw wheel; and "result" as rotating the satellite above the roll axis to compensate for the sinusoidal roll error introduced by inclined orbit. Lockheed elaborates that yaw momentum is zero in both the claimed invention and the Intelsat VII when either satellite is in an equatorial orbit, and that when

operation switches to inclined orbit both satellites introduce a yaw momentum that varies sinusoidally about zero ("function"). Lockheed then explains that both devices create this yaw momentum by adding a sinusoidal input to the yaw wheel that was not already there ("way"), and that[**15] both devices compensate for the sinusoidal pointing error created by inclined orbit ("result"). Lockheed concludes that a factual dispute exists as to whether there is infringement under the doctrine of equivalents, such that summary judgment would be inappropriate.

In its equivalence analysis the Court must adhere to the "all-elements" rule of Warner-Jenkinson, and determine the appropriate scope of the "missing" element to be analyzed. The missing element here is the "means for rotating" of paragraph (b). SSL's argument that its reaction wheel functions as a backup is unpersuasive, because it does not account for the function of the wheel once it begins to rotate. Furthermore, it confuses the function of element (a) with that of element (b). Several other SSL arguments are not directed at the narrow focus of missing element (b). Likewise, Lockheed's arguments are not focused on the respective "means for rotating" of each device, but instead tend to compare devices as a whole. The definitions of function, way, and result proposed by the parties are therefore flawed, and the Court must first determine them.

Element (b) itself calls for a means having the function of "rotating [**16]said wheel" by way of using "a predetermined rate schedule which varies sinusoidally" with the result that "the attitude of said satellite is offset . . . to null said roll pointing error due to said orbit inclination." In analyzing solely for element (b), it appears that the Intelsat VII does have a means for rotating its transverse wheel and that this means does

result in an attitude offset to null roll pointing error due to orbit inclination. Consequently, this Court cannot find as a matter of law that the "function" and "result" of the accused element are not substantially the same as those of the claimed element. The non-infringement analysis thus ultimately turns on whether any material factual dispute exists that could cause a reasonable jury to conclude that any element in the accused device rotates its transverse wheel in substantially the same "way" that claimed element (b) does.

SSL proposes that the "way" is "to generate a signal to alter the wheel rate, so that the wheel speed passes through zero twice per orbit and moves in a sinusoidal fashion," and Lockheed offers the simpler "way" of "by sinusoidally varying the speed of a yaw wheel." The "way" proposed by SSL is[**17] quite detailed, but it does reflect the definition of "varies sinusoidally" from this Court's prior order. The "way" proposed by Lockheed, conversely, is problematic in that it uses "sinusoidally varying" inconsistently with this Court's prior claim construction. The Court declines to give these words any different meaning in its interpretation of "way" than it did in its prior order.

[*1101] Element (b) calls for use of "a predetermined rate schedule which varies sinusoidally." The term "varies sinusoidally" has already been determined to require "that the wheel speed passes through zero twice per orbit." Thus SSL's interpretation of "way" is correct. Because it is undisputed that the transverse wheel of the Intelsat VII does not pass through zero twice per orbit, the "way" of the "means for rotating" in the Intelsat VII is not substantially similar to the "way" of the claimed invention. No equivalent for element (b) exists.

Furthermore, if any theory of equivalence would vitiate a claim limitation, then there can be no infringement under the doctrine of equivalents as a matter of law. See *Tronzo, 156 F.3d at 1160.* In Tronzo, the plaintiff was not permitted to ignore[**18] a claim limitation that its cup have a "generally conical outer surface" by asserting that the accused hemispherical cups were "equivalent." See id. Likewise, Lockheed cannot ignore the claim limitation "varies sinusoidally" by asserting that the Intelsat VII has an "equivalent" that does not "vary sinusoidally" as the Court has construed this term. Because Lockheed has not alleged that any element of the Intelsat VII meets this limitation, its theory of equivalence would vitiate this limitation. The Court thus finds that element (b) of claim 1 of the *'772* patent is not present in the Intelsat VII through the doctrine of equivalents.

2. "means responsive to said wheel speed and direction signal"

Paragraph (f) of claim 1 of the *'772* patent calls for:

said orientation means including means responsive to said wheel speed and direction signal for modifying said attitude error signal to be non-responsive to said offset in attitude generated by said transverse wheel, said attitude offset being in addition to said roll attitude errors,

'772 patent at col. 10:37-42 (emphasis added). The parties have stipulated that "a means that is responsive to the portion[**19] of the element (c) signal which indicates wheel speed, but either does not receive or is not responsive to the portion of the signal that indicates the direction of rotation of the wheel, would not literally satisfy this limitation in element (f)." It is un-

disputed that the accused reaction wheel, while capable of rotating in either direction, does not change direction once it begins rotating in either L mode. It is also undisputed that the Intelsat VII has tachometers that generate signals indicative only of wheel speed, and that the Intelsat VII telemeters to its ground-based computer processors its tachometer readings, the commanded speed, and the measured transverse L wheel spin polarity (direction).

SSL contends that its satellites cannot satisfy element (f), because they contain no mechanism that receives or responds to a "direction" portion of a signal. SSL further argues that any directional or "wheel spin polarity" information is not used in the control loop of the satellite, and that such information is not necessary because the direction of the reaction wheel never changes. Lockheed counters that the ground-based computer processors operate as part of the control loop by[**20] responding to discrepancies between commanded and reported values. Wheel direction is obvious and can be inferred from the other signals given. Furthermore, should the spin polarity signal indicate an incorrect direction, this would result in an "exception condition" and the ground based computer processors would respond to correct the problem. SSL replies that paragraph (f) recites that its responsive means be for "modifying said attitude error signal to be non-responsive to said offset in attitude generated by said transverse wheel," and that this function is not accomplished by the ground-based computer processors of the Intelsat VII satellite.

Although its momentum wheels do not change direction, it appears that a signal for direction may exist in the Intelsat VII satellite structure. Even if Lockheed is correct that the ground-based computers [*1102] receive a signal indicative of wheel direction and are part

of the claimed control system, however, Lockheed does not even argue that any "means responsive to [a] wheel speed and direction signal" performs the function recited in paragraph (f). A direction signal may exist and a means for modifying an attitude error signal to be non-responsive[**21] to an offset in attitude generated by said transverse wheel may exist, but Lockheed does not argue that the "means for modifying" is responsive to any direction signal.

Lockheed's own arguments suggest that the function of the polarity or direction signal is to ensure that the wheel is spinning in the proper direction, and that the only means responsive to this signal is one that would reverse the wheel direction should this "exception condition" ever arise. The limitation requiring element (f) to be responsive to a wheel direction signal is simply not met, and thus element (f) does not exist in the Intelsat VII satellite. Any attempt at an equivalence analysis ends with the substantial difference in function between the accused means responsive to a polarity or direction signal and the function recited in paragraph (f). Accordingly, the Court finds that element (f) of claim 1 of the *'772* patent is not present in the Intelsat VII either literally or through the doctrine of equivalents.

CONCLUSION

For the foregoing reasons, the Court finds that neither element (b) nor element (f) of claim 1 of the *'772* patent is present in the accused devises either literally or under the doctrine[**22] of equivalents. The Court therefore GRANTS summary judgment in favor of SSL and holds that SSL has not infringed U.S. Patent No. *4,084,772* either literally or under the doctrine of equivalents.

IT IS SO ORDERED.

Dated: March 6, 2000

SUSAN ILLSTON

United States District Judge

JUDGMENT

In accordance with this Court's order filed March 7, 2000, judgment is hereby entered in favor of the defendant.

IT IS SO ORDERED.

Dated: March 7, 2000

SUSAN ILLSTON

United States District Judge

STATUTORY PROVISIONS

35 U.S.C. § 112, second paragraph:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

35 U.S.C. § 271(a):

> Except as otherwise provided in this title, whoever without authority makes, uses, offers to sell, or sells any patented invention, within the United States or imports into the United States any patented invention during the term of the patent therefor, infringes upon the patent.

35 U.S.C. § 132(a):

> Whenever, on examination, any claim for a patent is rejected, or any objection or requirement is made, the Director shall notify the applicant thereof, stating the reasons for such rejection, or objection or requirement, together with such information or references as may be useful in judging the propriety of continuing the prosecution of his application; and if after receiving such notice the applicant persists in his claim for a patent, with or without amendment, the application shall be reexamined. No amendment shall introduce new matter into the disclosure of the invention.